Automated Ground Terminal to Reduce Satellite Tracking Costs

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A new fully automated, miniaturized antenna station built from off-the-shelf electronic components will reduce the cost of tracking NASA's low-Earth-orbit satellites. The station, called a Low Earth Orbit (LEO) Terminal, was built at Jet Propulsion Laboratory (JPL) and tested to track and command the Cosmic Background Explorer (COBE) satellite without operator intervention.

"Analysis of the terminal logs and spacecraft telemetry indicated that the terminal worked flawlessly during the demonstration," said Nasser Golshan, task manager of the development effort.

Development

Development of the terminal was carried out in two phases by a small team of engineers at JPL and SeaSpace Inc., a satellite ground terminal manufacturer in San Diego, California. In the first phase, JPL upgraded a commercially available weather satellite-tracking terminal and developed a receive-only terminal to gather telemetry from NASA satellites.

That first phase was completed in 1994 with successful demonstrations tracking the Solar Anomalous and Magnetospheric Particle Explorer and the Extreme UltraViolet Explorer. In the second phase, command uplink capabilities were added and showed that the terminal's operation could be completely automated using COBE.

About the terminal

The terminal antenna is enclosed in a fiberglass dome called a radome. The radome protects the microwave electronics and the tracking mechanism from the elements. A four foot high cabinet houses the station electronics. For testing purposes, the terminal is located on the roof of an eight-story building at JPL.

Electronics include the telemetry receiver, a command exciter, the antenna controller and a computer workstation. When transmitting, the terminal uses a 200 watt solid state transmitter power amplifier.

The computer workstation allows for automated, unattended operations of the terminal including automated scheduling, calculation of orbital trajectories, control of the antenna positioner for spacecraft tracking, automated uplink and telemetry operations, communication interfaces for remote command operations, as well as processing and distribution of spacecraft engineering and science data to the mission operations and science users of the data.

The terminal can receive telemetry at rates up to 1.2 million bits per second. Uplink commands can be sent at up to 2,000 bits per second. Those rates and the operating frequency can be modified with replacement equipment.

Equipped with a 10 foot (3 meter) antenna dish, the terminal is capable of providing telemetry and command support to up to 55 percent of NASA's current and planned LEO missions. A 16 foot (5 meter) dish could extend coverage to 70 percent of the missions.

A benchmark

Commercial off-the-shelf software has been used extensively to reduce cost and increase reliability. Costs of the equipment and software are between $600,000 and $800,000 depending on the options.

"This demonstration sets a benchmark for low cost support of Earth-orbiting missions," said Chad Edwards, manager of the Deep Space Network Technology Program at JPL. "It also shows NASA can work closely with industry to take the best available commercial capabilities and quickly adapt them to meet the needs of NASA science missions."

NASA's wealth of technology is being re-used in the fields of medicine, industry, and education and by the military to develop products and processes that benefit many sectors of our society. Spinoff applications from NASA's research and development programs are our dividends on the national investment in aerospace.